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PRODUCTION OF FLOAT-GLASS OF GREATER THAN EQUILIBRIUM THICKNESS

T. A. Egorova,[1] V. Ya. Matveenko,[1] V. I. Kondrashov,[1] and V. A. Gorokhovskii[1]

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A new method for producing glass of greater than equilibrium thickness has been developed, whose main principle consists in developing a compressive force along the glass band axis using several pairs of edge-restricting machines. Application of this method makes it possible to produce high-quality thickened glass 1700 – 1800 mm wide, to lower losses by shortening the time of transition from one glass thickness to another, and to avoid a decrease in the machine efficiency when making thicker glass.

The production of float glass of greater than equilibrium thickness is implemented by restricting the lateral spreading of glass melt in the front part of the melt tank and subsequent cooling of the glass band to preserve the attained thickness. The multitude of techniques of restricting lateral spreading is motivated by the search for the optimum molding conditions for thickened glass [1].

Various mechanical means of restriction are the ones most frequently used in glass production and include various restrictors and pushers. However, the world practice knows the experience of producing glass 8 – 20 mm thick without using restrictors [2]. Our aim as well was to obtain glass of greater than equilibrium thickness without using lateral restrictors.

Our studies on an industrial production line identified a dependence of the glass band width on the drawing velocity in thinning (Fig. 1). It was also established that the maximum thickness in the zone of the first pair of edge-restricting machines is approximately 13 mm [3]. This suggested that it is sufficient to preserve the initial glass band thickness (13 mm) up to its exit from the melt tank in order to obtain thickened glass.

However, the solution of this problem is complicated by the fact that the working velocity corresponding to this thickness for the particular production line is 70 – 80 m/h for a band width of 2700 – 2800 mm. Such correlation between the thickness, the width, and the working velocity is in fact unacceptable for high-efficiency lines as well as for float mini-plants. The configuration of most melting tanks is such that the tail part of the tank is significantly narrower than the front part and cannot let through the band of such width that can be obtained in the front part of the tank.

Therefore, to produce a glass band up to 12 mm thick and up to 2000 mm wide on the production line considered, it is necessary either to decrease the output rate, which results in economic losses, or increase the working velocity, which inevitably makes the band not only narrower, but thinner as well, which is undesirable.

This problem was solved in developing a new method for producing a glass band of greater than equilibrium thickness (RF patent No. 2181345), whose main principle consists in developing a compressive force along the glass band axis using several pairs of edge-restricting machines. The force is developed due to a special molding regime, when the velocity of each subsequent pair of edge-holding machines is lower than that of the preceding pair, and the velocity of the last pair approaches the velocity of the roller conveyer: $v_1 > v_2 \cong v_3$ (Figs. 2 and 3). The glass band in the active molding zone widens insignificantly and becomes thicker. The edge rollers can be positioned at a slight angle to the longitudinal axis of the band and thus can develop an additional

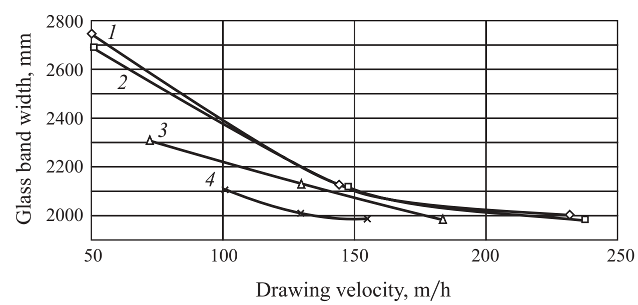

Fig. 1. Variation of glass band width at various stages of molding depending on the drawing velocity (output 100 ton/day): *1*, *2*, *3*, and *4*) glass thickness of 3, 4, 5, and 6 mm, respectively.

[1] Saratov Institute of Glass, Saratov, Russia.

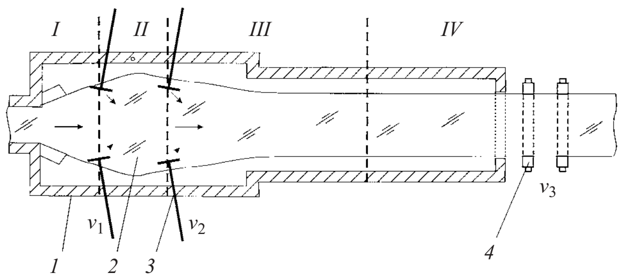

Fig. 2. Scheme of equipment layout in the melt tank in production of thickened glass: *1*) a tank with tin melt; *2*) glass band; *3*) edge-holding machines; *4*) rolls of the annealing furnace conveyor; *I*) spreading zone; *II*) zone of spreading restriction by edge-holding machines; *III*) zone of effect of the annealing furnace roller conveyer; *IV*) cooling zone; v_1 and v_2) velocities of the first and the second pair of edge-holding machines; v_3) velocity of the roll conveyor of the annealing furnace.

compressive force directed from the edges to the center of the band.

The described method made it possible to do without lateral restrictors and to produce a thickened glass band (up to 12 mm) using only edge-holding machines, since the established high-velocity molding regime, as well as cooling of the edge sites of the band as a consequence of contact with the water-cooled parts of the edge-holding machines, prevent lateral spreading.

An experimental batch of glass 10 – 12 mm thick was produced.

Experimental works on the industrial line demonstrated the advantages of the proposed method for producing glass of greater than equilibrium thickness.

The use of the new technology makes it possible to produce thick glass of sufficiently good quality and width of 1700 – 1800 mm. In this case there is no need to decrease by 8 – 10% the output rate of the plant when making thick glass.

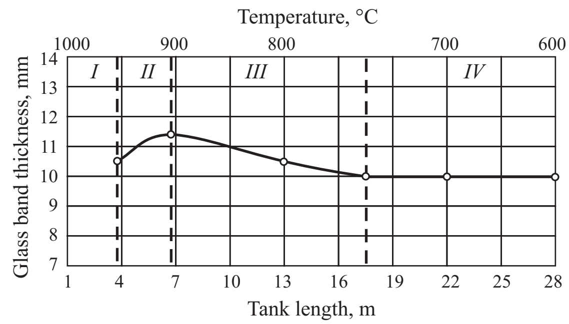

Fig. 3. Variation of glass band thickness at various stages of molding (output 100 ton/day, glass thickness 10 mm): *I*) spreading zone, *II*) zone of restricting spreading by edge-holding machines; *III*) zone of effect of the annealing furnace roller conveyer; *IV*) cooling zone.

By increasing the velocity of the first pair of machines to 120 – 130 m/h, it is possible to significantly decrease losses involved in the limitations of the plant efficiency when converting from thin-gage glass to thick glass. The edge-holding machines that are placed in the same zones of the melt tank as in making thin glass decrease the time of transition from one grade of thickness to another.

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